

U.S. DEPARTMENT OF COMMERCE
Office of Inspector General



**PUBLIC
RELEASE**

***UNITED STATES PATENT
AND TRADEMARK OFFICE***

***Search System Problems Being
Addressed, but Improvements
Needed for Future Systems***

Inspection Report No. OSE-12679/March 2001

Office of Systems Evaluation

Exhibit C



TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
BACKGROUND	1
OBJECTIVES, SCOPE, AND METHODOLOGY	6
FINDINGS AND RECOMMENDATIONS	7
I. Management Has Addressed Many Problems Effectively	7
II. Decision Authorities Need to Be More Involved and Have Better Progress Information	8
A. Decision Authorities Need to Approve the Completion of All System Life-cycle Phases	9
B. Decision Authorities Need Quantitative Information to Assess Progress	10
C. Recommendations	11
D. USPTO Response and OIG Comments	11
III. System Requirements Need to Be Fully Specified	12
A. Recommendations	13
B. USPTO Response and OIG Comments	13
IV. Acceptance Testing Needs to Be Improved	13
A. Formal Qualification Testing Needs to Be Improved	14
B. Beta Testing Needs to Be Improved	14
C. Recommendations	15
D. USPTO Response and OIG Comments	15
V. Communication with End Users Needs to Be Improved	16
A. Recommendations	17
B. USPTO Response and OIG Comments	17

VI.	Users' Proficiency Needs to Be Ensured	
	Before Systems Become Operational	17
A.	Recommendations	19
B.	USPTO Response and OIG Comments	19

APPENDIX: USPTO's Response to the Draft Report

EXECUTIVE SUMMARY

Patent examiners determine the uniqueness of a submitted patent by searching previously granted U.S. and foreign patents and relevant non-patent literature, such as technical journals, collectively called "prior art." Before the advent of automated searching, examiners searched only paper patents to determine uniqueness. Since the U.S. Patent and Trademark Office (USPTO) introduced its first patent search system in 1986, examiners have increasingly relied on automated systems to search prior art. The objective of automated searching is to improve patent quality and maintain examiner productivity as the volume of patent filings increases.

In 1994, USPTO decided to replace its primary search system, Messenger, because the technology was becoming obsolete and capacity limitations were making it difficult to support the needs of the rapidly growing patent examining corps. USPTO also concluded that making Messenger year 2000 compliant would be uneconomical. Consequently, USPTO decided to allow the license for Messenger to expire and remove the system from operations by September 30, 1999. Thus, the new search system had to be ready to support operations at that time. The Patent Commissioner and USPTO's Chief Information Officer (CIO) were the designated "decision authorities" for the search system program, with responsibility for monitoring progress and approving key decisions.

The objectives of this evaluation were to assess the development and operation of USPTO's new search system to (1) determine whether it is adequately supporting patent application processing and (2) identify lessons learned that can be applied to future system programs.

The firm deadline, coupled with schedule delays, put a great deal of pressure on the program and contributed to the problems we found. To help ensure a smooth transition, a full year of parallel operations was planned before Messenger was to be discontinued. However, because of delays, the new system was not fully deployed until the end of August 1999, leaving only one month for parallel operations. When it began operating, the system performed poorly, providing slow response times and crashing frequently, causing examiners to lose work and time and making it more difficult for them to meet their production quotas. Compounding these problems was the fact that examiners were not adequately trained on the new system.

We found that USPTO management acted quickly to resolve many of these problems. Actions included fixing most of the system's slow response time and instability problems, relaxing examiners' work rules to mitigate the effect of the problems on their production rates, and increasing communications with examiners. The new search system's performance has improved, and it has largely fulfilled its primary goal of overcoming Messenger's limitations. (See page 7.)

At the same time, we identified the following improvements that should be applied to future systems development efforts:

- **Decision authorities need to be more involved and have better progress information.** As the decision authorities, the Commissioner for Patents and the CIO were responsible for program monitoring and signing off on key decisions at the end of certain life-cycle phases. Although the decision authorities were monitoring progress, they were not involved in some key decisions and did not have the information they needed to effectively assess progress and risks. Consequently, they missed opportunities to intervene to mitigate problems. USPTO should strengthen the role of the decision authorities at the end of each system life-cycle phase and provide them with quantitative information about program progress so that they can better manage major information systems programs. (See page 8.)
- **System requirements need to be fully specified.** Two critical requirements were not adequately addressed in the requirements specification for the new search system. Text search response time was not fully specified, and stability requirements were not specified at all. Because specifications are the basis for system design, development, testing, and acceptance, we believe that the incomplete specifications contributed to the system's slow response times and frequent crashes. USPTO should strengthen its process for defining and documenting requirements to ensure that all requirements are included and fully delineated in requirements specifications. (See page 12.)
- **Acceptance testing needs to be improved.** USPTO conducted a series of tests to determine if the new search system was ready to be accepted and placed into operations, but significant stability and response time problems were overlooked. USPTO should strengthen its acceptance testing procedures in order to improve its ability to field systems that are ready for operations. (See page 13.)
- **Communication with end users needs to be improved.** Although some examiners participated in some system life-cycle activities, many of them stated that they were not adequately involved in the system development process and expressed dissatisfaction with the new system. We believe that the examiners' dissatisfaction stems from inadequate communications with the program manager and developers and lack of a significant, formalized role. USPTO should involve the examiners throughout the life-cycle and formally define and document their roles in order to increase the likelihood that their needs and expectations will be met when a system is delivered. (See page 16.)
- **Users' proficiency needs to be ensured before systems become operational.** Although schedule delays prevented training of the examiners on the new search system from being completed, USPTO believed that the examiners were proficient enough to use it.

However, training proved to be insufficient, and examiners had difficulty using the system. USPTO should evaluate the proficiency of examiners before new systems are placed into operations and adjust training accordingly. (See page 17.)



In USPTO's response to our draft report, the Acting Under Secretary of Commerce for Intellectual Property and Acting Director of the United States Patent and Trademark Office expressed his appreciation for the thoroughness of our review and indicated that many of our recommendations will be applied to future system programs. USPTO concurred with our observations and 10 of our 12 recommendations, and has already begun implementing many of them.

Specifically, USPTO has started making substantive changes to its system life-cycle management methodology. These actions include (1) developing a life-cycle metrics program for evaluating program progress and system quality; (2) changing requirements development procedures to improve the quality of requirements specifications; (3) strengthening test procedures by making formal qualification testing more realistic, preparing new beta test guidance for end users, and using quality metrics to evaluate system products before accepting them; (4) increasing end-users' involvement early and throughout the system life-cycle; and (5) providing additional opportunities for end user training. These actions should lower system development costs, improve system quality, and promote end user acceptance of new systems.

The two recommendations that USPTO disagreed with concerned the role of the program decision authorities. USPTO states that the CIO and program sponsor are adequately involved in system programs because they are regularly briefed by their program managers and programs are discussed at quarterly agency-wide business unit reviews. However, we continue to believe that the CIO and program sponsor should be required to approve and should have the accountability associated with signing off on the completion of each life-cycle phase of major information systems. They should have this formal role because they are the only officials with the authority to make significant changes to major program commitments, such as cost, schedule, and high-level requirements. Moreover, federal guidance requires decision authorities to make key life-cycle decisions for major information system programs. Therefore, we reaffirm our recommendations.

USPTO's full response is included as the Appendix to this report.

BACKGROUND

The mission of the United States Patent and Trademark Office (USPTO) is to promote economic progress by administering patent and trademark laws and advising the executive branch on intellectual property protection. A patent is a grant given by the U.S. government to an inventor that secures, for a limited time, his or her exclusive right to make, use, or sell the invention in exchange for disclosing a description of the invention.

Automated Searching

For an invention to be patented, it must be new, useful, and not obvious. Patent examiners determine the uniqueness of a submitted patent by searching previously granted U.S. and foreign patents and relevant non-patent literature, such as technical journals, collectively called "prior art." Previously, examiners searched only paper patents, filed in cabinets called "shoe boxes," to determine patent uniqueness. However, since the introduction of the patent search system in 1986, examiners have relied increasingly on automation to search prior art.

Before the new search system was introduced, examiners used Messenger, an automated search system licensed from the Chemical Abstract Service. Messenger searched the U.S. patent database, which contains about 2.5 million U.S. patents granted from 1971 to the present. Examiners located patents of interest by entering a series of keywords usually using their desktop computer. Messenger, which ran on a mainframe computer, would then search its database to find patents that contained the keywords and return them for viewing. The objective of automated searching was to improve patent quality and maintain examiner productivity as the volume of patent filings increased.

In 1994, USPTO concluded that it would be more economical and efficient to meet the growing search needs of the patent business with newer technology and decided to replace Messenger. Messenger was limited to 200 users logged on at the same time and could not support the rapidly growing patent examining corps without expensive upgrades. Also, because Messenger was built from older, proprietary technology, it was expensive and time consuming to install additional prior art databases or integrate Messenger with newer patent systems. Another reason USPTO gave for replacing Messenger was that it was uneconomical to make it year 2000 compliant.

Acquisition and Development Approach

USPTO follows a standard life-cycle management (LCM) methodology that it developed for acquiring and developing information systems. The LCM methodology defines organizational responsibilities and procedures for moving a system through a series of life-cycle phases. Table 1 summarizes the purpose of each phase. The program sponsor and USPTO's Chief Information Officer (CIO) work closely in a partnership and are the "decision authorities" for the program.

They are responsible for monitoring the program and signing off on key decisions at the end of certain life-cycle phases. The sponsor identifies business needs, ensures that the system being developed meets those needs, and provides resources for the program. The CIO determines how best to use information technology to fulfill the identified business needs and is responsible for the purchase, development, and integration of the system. The sponsor for the new search system program is the Commissioner for Patents. The Search and Information Resources Administration (SIRA) in the Patent Commissioner's office manages the search system program.

Table 1
USPTO System Life-Cycle Phases (Before Operations)

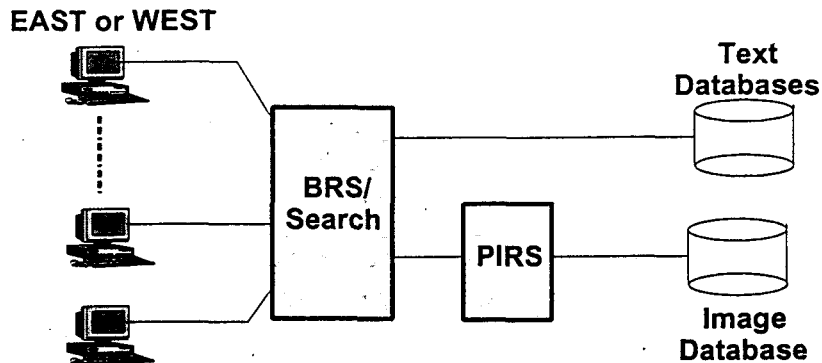
Phase	Purpose
Initiation	Identify business need for the information technology program
Concept	Investigate alternative implementation approaches and choose one
Detailed analysis	Translate requirements into a system design
Development	Refine design and code, integrate, and test system
Deployment	Prepare end users and logistics for operations

The New Search System

The new search system consists of four components in a client-server arrangement (see Figure 1).¹ The two search system clients, called EAST and WEST, reside on the examiner's or other end user's desktop computer. The clients are connected via USPTO's in-house network to a server computer on which the patent text search software package, called BRS/Search, resides. The server is connected to the U.S. patents and other prior art databases, which the end user can search, as well as to the patent image server system, called PIRS, which is used to retrieve full images of patents. BRS searches and returns the textual portions of patents and passes images retrieved by PIRS to EAST and WEST.

¹Typically, a client-server system is composed of client software running on desktop computers that issue requests to a more powerful server computer that is dedicated to providing a particular service to clients (e.g., database or printer services).

Figure 1
USPTO New Search System - Client-Server Diagram



EAST, the Examiners Automated Search Tool, has a Microsoft Windows style user interface, is highly customizable, and has better image retrieval performance. WEST, the Web-based Examiner Search Tool, has a simpler web browser style user interface and is easier to upgrade. BRS/Search, the Bibliographic Retrieval System, is a commercial off-the-shelf text search software package licensed from Dataware Technologies. PIRS, the Patent Image Retrieval System, is a component of the search system that was built as part of another information technology program. EAST and WEST replace old client software that ran on examiners' desktop computers. BRS/Search replaces the Messenger search system that resided on the mainframe computer. EAST has become the primary system client used by the examining corps.²

New Search System Life-cycle

In 1995, the new search system first appeared in USPTO's five-year Strategic Information Technology Plan, showing full deployment by FY 2001. In July 1997, BRS/Search was selected to replace Messenger. In that same year, USPTO decided not to make Messenger year 2000 compliant and to allow the licenses for Messenger and its mainframe computer to expire at the end of FY 1999. This decision shortened the schedule and established a firm deadline for when the new search system would have to be ready for operations.

The shortened schedule and firm deadline, coupled with schedule delays, put a great deal of pressure on the program and contributed to the problems we found. According to the CIO, the

²In March 2000, over 1,000 more examiners used EAST than WEST (2821 versus 1795) and five times as many search queries were performed on EAST than WEST (767,859 versus 148,294).

program began late because the General Services Administration had temporarily suspended USPTO's procurement of system development and maintenance services. When USPTO eventually procured these services, the contractors were slow to bring in qualified personnel. Then, because the start of user pilot testing of BRS and the WEST client was delayed by four months to November 1999, only 10 months remained for the critical system development activities of debugging BRS and integrating and testing it with the EAST client.

Because the new search system was complex, USPTO planned to operate it in parallel with Messenger for one year. This time would be used to fix problems and let the examiners become proficient with the new system while Messenger was available as a backup. BRS with the WEST client was deployed to the entire examining corps by the end of June 1999 to allow examiners to become familiar with BRS; however, examiners were reluctant to stop using Messenger and start using WEST and BRS. Final testing of EAST and BRS was not completed until the end of July 1999, and the system was not fully deployed until the end of August. This left only one month for examiners to become familiar with EAST and BRS before Messenger was shut off.

The deadline for shutting off Messenger was extended from September 30 to October 9 so that examiners could complete their end-of-year activities. When Messenger was shut off on October 9, EAST and BRS became the primary operational system. Another release of EAST was put into operations on October 12 to fix stability and other problems found during testing and deployment.

Operational Problems

Although USPTO improved system speed and performance during development, the system performed poorly when it went into operations. Initially, the average text search response time for the new system was 51 seconds, three times longer than Messenger's 17 seconds for FY 1999. Also, BRS was very slow in responding to some typically used search queries, taking minutes rather than seconds. In addition, the system had operational problems, especially frequent crashes, causing examiners to lose work and time and making it more difficult for them to meet their production quotas. As a result, calls to the help desk almost doubled. Compounding these problems was the fact that examiners were unfamiliar with the system.

Many examiners relied on automated searching, but the new search system was not meeting their needs. Some examiners were so frustrated that they protested to the USPTO Commissioner and the Congress. Despite the abundant system problems, USPTO maintains that its statistical data shows that examiner productivity did not suffer: examiners were processing patents at the same rate as a year earlier. However, any impact these problems may have had on the quality of patent examinations is difficult to determine.

USPTO Response and OIG Comments

We incorporated USPTO's clarifications about the capabilities of EAST and WEST into the background section of our report. However, we do not agree with USPTO that deploying WEST 1.0 and BRS with the Derwent database in August 1998 partially achieved the risk mitigation goal of having one year of new search system operations before Messenger had to be shut off. The WEST-BRS system deployed in 1998 only partially resembled the new search system and was seldom used. The WEST-BRS system that was to become part of the new search system was deployed much later, in June 1999. Unfortunately this system was not heavily used, and EAST-BRS was not deployed until the end of August 1999, leaving only one month of operation before Messenger had to be shut off.

OBJECTIVES, SCOPE, AND METHODOLOGY

The objectives of this evaluation were to assess the development and operations of USPTO's new search system to (1) determine whether it is adequately supporting patent application processing and (2) identify lessons learned that can be applied to future system programs.

Our review methodology included interviewing USPTO employees, reviewing documentation, and participating in system demonstrations. We interviewed patent examiners, including Patent Office Professional Association (POPA) representatives, supervisory examiners, search system trainers, search system program and line managers, and the executives involved in the program: the Patent Commissioner, the Administrator of SIRA, and the CIO. We reviewed many documents, including USPTO's five-year *Strategic Information Technology Plans*; system documentation, such as system specifications, training plans, and test plans and reports; life-cycle meeting minutes; system performance statistics; help desk logs; Patent Business Office memorandums; and e-mail correspondence. We observed a demonstration of the new search system and also participated in a hands-on demonstration.

Our fieldwork was conducted from February through September 2000. Although USPTO started considering replacing the old search system in the early 1990s, our work looked at activities that took place between July 1995 and July 2000. Our evaluation focused on EAST, the primary client used by the examining corps, and BRS, the replacement for Messenger. Although we referred to USPTO's system life-cycle management methodology, evaluating it was beyond the scope of this inspection. Before presenting our findings and recommendations at an exit conference with USPTO on September 12, 2000, we discussed this information with the Commissioner for Patents, the SIRA Administrator, the CIO, and the program managers, who agreed with most of our recommendations and have already begun to implement them.

Our evaluation was conducted in accordance with the *Quality Standards for Inspections* issued by the President's Council on Integrity and Efficiency, and was performed under the authority of the Inspector General Act of 1978, as amended, and Department Organization Order 10-13, dated May 22, 1980, as amended.

FINDINGS AND RECOMMENDATIONS

I. Management Has Addressed Many Problems Effectively

USPTO management has resolved most of the problems caused by the introduction of the EAST and BRS system. Actions taken included fixing most of the system's slow response time and instability problems, relaxing examiners' work rules so that the system did not adversely affect their production rates, and increasing communications with examiners and POPA. USPTO's indicators show that the new search system's performance has improved and that it has largely fulfilled its goal of overcoming Messenger's limitations.

USPTO management acted quickly to fix response and stability problems with the new search system. One month after the system went into stand-alone operations, USPTO was able to replace the BRS/Search server computer, doubling its computing power and increasing memory size, by diverting an order for a larger computer placed by the Office of Trademarks. By the end of November 1999, response time was further improved by adding more disk storage and reducing bottlenecks to accessing the prior art databases. Also, by May 2000, USPTO released four software enhancements to EAST and doubled the memory size of the client desktop computer to reduce the number of system crashes.

USPTO management also worked with POPA to ease the impact of system problems on examiners' productivity and performance ratings. In November 1999, charge codes were added to make it easier for examiners to charge for time lost due to system problems. USPTO also planned to adjust supervisors' production goals at the end of the fiscal year so that their performance ratings would not be adversely affected when examiners charged to these codes. To improve system performance, USPTO extended the hours during which examiners could work and increased compensatory time and credit hours to shift use of the system away from peak hours (9:30 a.m. to 3:00 p.m.). Also, USPTO developed new training courses and increased examiner training time from 8 to 20 hours.

Management also increased communications with POPA in order to better elicit examiners' concerns about the new search system. In November 1999, an Automation Task Force was formed to give examiners and their supervisors an opportunity to discuss problems directly with program managers and system developers. The task force effectively identified such issues as the need for extended work hours. In February 2000, USPTO and POPA formally established a Search Tools and Automation Partnership Working Group to obtain examiners' input about the search system and other patent processing systems and to develop a process for their involvement in system programs.

The new search system program was complex, and the system experienced significant problems when it went into operations. However, USPTO has recovered from most of these problems, and

the new system appears to be adequately supporting patent processing. USPTO's statistics show that EAST and BRS are meeting the CIO's service commitment of responding to 80 percent of the search queries in less than 30 seconds. Average text search response time has been reduced from approximately 50 seconds in November 1999 to less than 20 seconds in December 1999.³ In addition, examiner complaints about the system have subsided. By January 2000, help desk calls due to problems with the new search system had fallen by 86 percent, and examiners' complaints are heard much less frequently in on-line chats with the USPTO Commissioner. Despite these improvements, EAST and BRS have not responded in 30 seconds to some of the new benchmark search query specified by examiners. Also, the system is not meeting some of the more demanding response time requirements documented in EAST's requirements specification.

The new search system has accomplished its fundamental goal of overcoming the serious limitations of Messenger. It is routinely supporting up to 500 simultaneous users as compared to the 200 users that Messenger could accommodate. It is searching more databases and has integrated text search and patent image retrieval. The system is also year 2000 compliant. Finally, as a result of the problems encountered on the new search system program, USPTO management is rethinking how to manage system programs more effectively and increase end user involvement.

II. Decision Authorities Need to Be More Involved and Have Better Progress Information

Although the decision authorities were monitoring progress, they were not involved in some key decisions and did not have the information they needed to effectively assess progress and risks. Consequently, they missed opportunities to intervene to mitigate problems. USPTO should strengthen the role of the decision authorities at the end of each system life-cycle phase and provide them with quantitative information about program progress so that they can better manage major information systems programs.

Federal guidance for the acquisition of major information systems requires agency decision authorities to make key life-cycle decisions. Decision authorities are responsible for taking actions when significant problems arise in fulfilling schedule, cost, or requirement commitments. USPTO implemented this guidance in its system life-cycle management methodology. The LCM designates the program sponsor and the CIO as the decision authorities for system programs and

³Because response times for EAST text searches and patent image retrievals are not measured individually, the actual text response time must be derived from this combined measurement. In December 1999, the average combined response time was 12.5 seconds. However, USPTO reports that text search response time may be as much as 50 percent higher, i.e., 18.75 seconds because text searches take much longer than image retrievals.

makes them responsible for monitoring program progress and making key life-cycle decisions. As noted, the Commissioner for Patents is the program sponsor.

Decision authority monitoring was particularly critical for the search system because of both its importance to examiners and its significant complexity and risks. Although examiners are not required to use automated searching, in FY 1999, three-quarters of them relied on it for performing their work, an increase of 13 percent from the previous year. Also, session hours increased by 36 percent. The risks faced by the program were (1) schedule risk, because of the firm deadline; (2) technical risk, because the new search software had never been implemented in an environment as demanding as USPTO's; and (3) user acceptance risk, because the new system was significantly different from Messenger.

Although the decision authorities monitored the program, they did not foresee the serious problems the system would have when it went into operations. For example, the Patent Commissioner did not know that one of the most important features of the new search system—its ability to respond to search queries at least as fast as Messenger—had not been confirmed for a realistic number of simultaneous users. Similarly, neither the CIO nor the Patent Commissioner was aware of the severity of the system's stability problems until it went into operations. We believe that the decision authorities did not know about these problems because they were not adequately involved in making key life-cycle decisions and did not have quantitative information to assess program progress and risks.

*A. Decision Authorities Need to Approve the
Completion of All System Life-cycle Phases*

USPTO's LCM does not require the CIO or the program sponsor to formally approve the completion of two of the five system life-cycle phases, the detailed analysis phase and the development phase. However, management information about the results of both of these phases is critical for determining if the program is progressing as planned and if it can proceed to the next phase without undue risk. During the detailed analysis phase, requirements are translated into a system design. By the end of this phase, information is available about how stable the requirements are and whether they are likely to be implemented within program schedule and cost commitments. During the development phase, the system is built according to the design and then tested. By the end of this phase, conclusive information should be available about whether system requirements have been satisfactorily implemented and whether the system is ready for deployment to end users.

USPTO's LCM requires that the CIO and the program sponsor formally approve the completion of three phases of the system life-cycle, initiation, concept, and deployment. Approvals are recorded as a signature on system documentation. However, we found that the decision authorities did not formally approve the completion of some of the phases in the new search system program. At the end of the concept phase, the CIO and program sponsor are to review the

system boundary document and agree that it reflects a mutual and detailed understanding of program commitments. At USPTO, program commitments are identified in the system boundary document and include schedules, costs, high-level system requirements, and special considerations, such as user acceptance challenges. However, USPTO could not provide evidence that the decision authorities had signed the system boundary document for either EAST or the Messenger search software replacement. Similarly, at the end of the deployment phase, the decision authorities are to review and approve the systems deployment decision paper, which describes why the system and its logistics are ready for operations. Although a decision paper was submitted for WEST and BRS, USPTO could not provide evidence that it was formally approved. Also, no decision paper was submitted or formally approved for EAST.

***B. Decision Authorities Need Quantitative Information
to Assess Progress***

Reportedly, the decision authorities met weekly with their staffs to discuss program status, as well as management and technical issues that needed to be resolved, but these discussions did not focus on assessing progress in meeting program commitments.

Information technology organizations with mature life-cycle processes use quantitative measures, or metrics, to evaluate progress in achieving program commitments. For example, a measure of system quality based on the number of errors discovered during testing per lines of system code, called "fault density," is a good indicator of the number of errors remaining and whether the system is ready for operations. Similarly, the number of changes to system requirements during development, called "requirements volatility," is an important indicator of whether requirements are stable and, therefore, whether schedule and cost commitments can be met. Also, progress in implementing high-level requirements can be tracked by determining how many of their component requirements have been completed.

If the decision authorities had been using appropriate quantitative measures to assess progress, they could have foreseen significant problems early enough to resolve them effectively. For example, if they had been tracking the activities for implementing and testing the high-level requirement of search system response time, they would have found that an acceptable time had not been confirmed. They then could have allocated additional resources to complete the task or relaxed examiner work rules before the new search system went into stand-alone operations. In general, quantitative measures would provide the decision authorities with a basis for determining whether each life-cycle phase has been completed; for assessing the likelihood of meeting cost, schedule, and requirement commitments; and for deciding whether the next program phase could be started without undue risk.

The search system decision authorities and their staffs have agreed that better information about program progress, including quantitative measures, would improve their ability to assess and manage system programs.

C. *Recommendations*

We recommend that the Under Secretary for Intellectual Property and Director of the United States Patent and Trademark Office direct the CIO, in consultation with the Commissioner for Patents, Commissioner for Trademarks, Chief Financial Officer, and Chief Administrative Officer, to revise the LCM as follows, for major information system programs:

1. Extend the decision authorities' responsibilities to reviewing and approving the completion of the detailed analysis and development phases.
2. Require that quantitative measures be prepared and that the decision authorities review them at the end of each life-cycle phase to help evaluate the progress made in achieving program commitments, such as cost, schedule, and high-level requirements.
3. Require the decision authorities to sign documentation attesting to the successful completion of each life-cycle phase.

D. *USPTO Response and OIG Comments*

USPTO concurs with our recommendation to develop life-cycle metrics for evaluating program progress and system quality. However, it disagrees with our recommendations concerning the role of the program decision authorities. USPTO states that the CIO and program sponsor are adequately involved in system programs because they are regularly briefed by their program managers and programs are discussed at quarterly agency-wide business unit reviews. USPTO also states that at life-cycle reviews the Technical Review Board, chaired by the deputy CIO and attended by the CIO's and sponsor's program managers, has the authority to approve and sign off on the completion of life-cycle phases.

However, we continue to believe that the CIO and program sponsor should be required to approve and should have the accountability associated with signing off on the completion of each life-cycle phase of major information systems. They should have this formal role because only they, and not the Technical Review Board, have the authority to make significant changes to major program commitments, such as cost, schedule, and high-level requirements. Moreover, decision authorities are required by federal guidance (OMB Circular A-130, *Management of Federal Information Resources*) to make key life cycle decisions for major information system programs. Therefore, we reaffirm our recommendations.

USPTO also took exception to the implication that could be drawn from our report about decision authorities' awareness of system stability problems. If USPTO adopts our recommendations, we believe that any uncertainty about decisions authorities' awareness of significant system development and acquisition issues would be avoided.

III. System Requirements Need to Be Fully Specified

Two critical requirements were not adequately addressed in the requirements specification for the new search system. Text search response time was not fully specified, and stability requirements were not specified at all. Because specifications are the basis for system design, development, testing, and acceptance, we believe that the incomplete specifications contributed to the system's slow response times and frequent crashes. USPTO should strengthen its process for defining and documenting requirements to ensure that all requirements are included and fully delineated in requirements specifications.

Requirements specifications are fundamental to the system life-cycle process. They identify the capabilities a system has to provide, and they serve as the basis for system design and development, as well as for testing and verifying that the system is ready for acceptance. USPTO developed the search system's software requirements specifications in accordance with Institute of Electrical and Electronic Engineers (IEEE) 830 standard, *IEEE Recommended Practice for Software Requirements Specifications*. The standard identifies five major categories of requirements—functional, performance, external interface, design constraints, and other system attributes—and the details that need to be specified for each category. According to the standard, the level of detail should be sufficient to design the system and to test that all requirements have been implemented completely and correctly.

Text search response time and system stability are two critical search system performance requirements. Examiners depend on fast processing of complex text search queries. Recognizing the importance of speed, the CIO has explicitly committed to having the search systems provide examiners with fast response times. The speed of text searches depends on the workload under which the system is operating. Workload is determined by such factors as the number of users logged on, the number of simultaneous searches, the complexity of the search query, and the number of databases searched. Similarly, stability is important because the system must be continuously available to examiners. System stability, typically called "availability," is the degree to which a system or component is operational and accessible when needed.

Although the EAST specification included a text search response time requirement, this requirement was incomplete because it did not specify the system workload. Specifically, the response time requirement did not include the anticipated number of users logged on or actively running searches. Availability was not specified at all in either the EAST or the Messenger search software replacement specifications. When the system went into operations, two of its major problems were slow response time and frequent crashes. We believe that response time and stability would have been better monitored and tested if they had been specified properly.

A. Recommendations

We recommend that the Under Secretary for Intellectual Property and Director of the United States Patent and Trademark Office direct the CIO to:

1. Revise the LCM procedures for specifying requirements to ensure that all requirements are identified and fully specified according to the categories and level of detail stipulated in the IEEE standard.
2. Update the new search system requirements specification to include fully specified text search response time (including workloads) and system availability.

B. USPTO Response and OIG Comments

USPTO concurs with our recommendations and has started implementing them. It has improved procedures for identifying and specifying system requirements, as well as clarified performance and availability requirements for the new search system. Specifically, USPTO has added a Detailed Level Requirements Review to the LCM procedures and plans to update the Requirements Management Technical Standard and Guideline to more fully address the requirement categories identified in the IEEE 830 Standard.

IV. Acceptance Testing Needs to Be Improved

USPTO conducted a series of tests to determine if the new search system was ready to be accepted and placed into operations, but significant stability and response time problems, as discussed previously, were overlooked. USPTO should strengthen its acceptance testing procedures in order to improve its ability to field systems that are ready for operations.

After a system is integrated and tested by the developers, tests are performed independently of the developer for the program sponsor and end users to determine if the system is ready to be accepted for operations. At USPTO, two kinds of acceptance tests are conducted, formal qualification testing (FQT) and beta testing. The purpose of FQT is to verify that the system performs according to its documented requirements. The purpose of beta testing is for end users to determine whether the system meets their needs by exercising the system as it is typically used in an operational environment, rather than against its written requirement specification, as is done in FQT. At USPTO, these are usually the last tests performed before the system is deployed to end users.

A. Formal Qualification Testing Needs to Be Improved

FQT should be comprehensive—all functional and performance characteristics described in the system requirements specifications should be tested. Requirements should be tested individually and in combination. They should be tested for average situations, for situations at the system boundaries (e.g., for minimum and maximum input values), and for out-of-bounds situations (“stress testing”). Stress tests are designed to demonstrate what a system’s limitations are and how it behaves when it fails. It is important that the system is tested under realistic conditions. For example, system response times should be tested under workloads expected during operations. Also, examiners can help develop typical search scenarios to test.

The CIO’s quality assurance contractor conducted the FQT for EAST in May 1999. However, FQT did not reveal the extent of EAST’s problems, leaving many to be found in beta testing and during operations. FQT identified 20 problems, 3 of which caused the system to crash. Although 19 of the problems were fixed, beta testing identified five times as many problems—109 problems, 25 of which caused the system to crash. USPTO issued three releases of EAST before Messenger was shut off on October 9 to fix problems found during beta testing and hurriedly issued a fourth release two days later to fix the remaining problems. USPTO issued three more releases by April 2000 to reduce system stability problems.

FQT was unsuccessful primarily because the system was not tested under realistic conditions and not stress tested. For example, the test of response time for text searching was conducted with a workload of 3 simultaneous users, when the system was expected to handle 600. As stated in Finding III, it is more likely that the system response time would have been tested under realistic conditions if the response time requirement had been fully specified with its expected workload. Similarly, USPTO stated that most requirements were tested under average conditions, rather than at or past their boundaries. The extent of system problems suggests that testing conducted by the system developer before acceptance testing may also have been inadequate.

B. Beta Testing Needs to Be Improved

Beta testing is needed because written system requirements do not necessarily capture all important user needs. At USPTO, beta testing offers the only opportunity for end users to test the system in its operational environment. According to USPTO guidance, beta tests should be planned, routine features tested, and results reported at the end of testing. Although the LCM does not offer guidance on beta test planning, an effective approach would both identify key requirements to test and allow *ad hoc* testing. Test reports should summarize the test results, along with end users’ critiques of the system, including whether they believe the system is ready for operations. Also, the system should be relatively free of problems so that beta testers can spend their time verifying that the system provides the functional and performance capabilities needed to do their jobs without having to deal with inaccurate results or system crashes.

EAST beta testing was conducted for a two-month period between May and July 2000 by 165 testers, including examiners, SIRA personnel, and other users. However, because the system was not adequately tested during FQT, beta testers encountered many system problems. These problems hindered end users from fully testing the system and determining whether it met their needs. USPTO released three versions of the system to fix problems found during beta testing. Because of the approaching deadline, however, significant problems were not repaired before the system went into stand-alone operations, including some that caused the system to crash. Also, the beta test documentation did not draw a conclusion about the testers' experience with the system or describe their assessment of its readiness for operations.

C. Recommendations

We recommend that the Under Secretary for Intellectual Property and Director of the United States Patent and Trademark Office direct the CIO to:

1. Revise the LCM procedures for Formal Qualification Testing to ensure that
 - a. End users participate in developing realistic test cases.
 - b. Systems are tested at and beyond system boundaries (i.e., are stress tested), in addition to being tested in average situations.
 - c. System requirements are tested under realistic conditions.
2. Revise the LCM procedures for beta testing to ensure that
 - a. Beta test plans are prepared that include plans for testing important requirements in addition to *ad hoc* testing.
 - b. A written end user evaluation of the test is required as one of the determinants of the deployment decision.
3. Revise the LCM testing procedures to ensure that the adequacy of the testing performed by the developer is reviewed before acceptance testing begins.

D. USPTO Response and OIG Comments

USPTO concurs with our recommendations and has started implementing them. It is taking steps to improve test procedures by making formal qualification testing more realistic, preparing new beta test guidance for end users, and using quality metrics to evaluate system products before accepting them. USPTO also plans to request funds for obtaining automated tools for testing system performance.

V. Communication with End Users Needs to Be Improved

Although some examiners participated in some system life-cycle activities, many of them stated that they were not adequately involved in the system development process and expressed dissatisfaction with the new system. We believe that the examiners' dissatisfaction stems from inadequate communications with the program manager and developers and lack of a significant, formalized role. USPTO should involve the examiners throughout the life-cycle and formally define and document their roles in order to increase the likelihood that their needs and expectations will be met when a system is delivered.

End user participation is important to the success of major information system programs. Representatives from the end user community should be part of a joint team consisting of a program manager, developers, and other stakeholders that participate in the evolution of the system throughout its life-cycle. End users should meet with other team members to define requirements, participate in evaluating system prototypes to refine requirements, and assist in acceptance testing to ensure that the system meets their needs.

Examiners had opportunities to participate in the new search system program. According to the program manager and CIO staff, examiners were one source of requirements. Moreover, in the early part of the program, a small group of examiners was selected to evaluate and discuss commercial off-the-shelf products being considered to replace Messenger. Additional examiner participation was solicited for system piloting and beta testing. In total, 60 examiners piloted WEST and BRS, and 90 examiners were part of the beta test group for EAST and BRS.

Despite this participation, the examiners we interviewed stated they were not adequately involved in the development process and were dissatisfied with the new system when it was deployed. Examiners stated on numerous occasions—including in comments about EAST beta testing, in a petition to the USPTO Commissioner, in a letter to the Congress, and in interviews with our office—that they do not receive feedback about their concerns from USPTO management. Examiners felt that they did not significantly influence the selection of the replacement search software and that when they were consulted (e.g., at beta testing), it was too late in the system life-cycle to have a significant influence.

We believe that the examiners' dissatisfaction stems from inadequate communications with the program manager and developers and lack of a significant, formalized role throughout the system life-cycle. Examiners were not always sufficiently represented in life-cycle activities, and when they did participate, they saw little evidence that they had influenced the characteristics of the system. Although user participation throughout the system life-cycle is noted in the LCM, users are not given a significant role and sometimes are not included when they are supposed to be.

USPTO should strengthen end users' involvement in system programs, including early in the system life-cycle so that they have more influence over the end product. As USPTO's LCM points out and industry has found, early user involvement increases the likelihood that requirements accurately reflect end user needs and that end users will embrace the newly developed system. In response to examiners' dissatisfaction with the new search system, USPTO and POPA established the Search Tools and Automation Partnership Working Group Team in February 2000 to resolve issues associated with automated tools and define a process for increasing examiner participation in the system life-cycle.

A. Recommendations

We recommend that the Under Secretary for Intellectual Property and Director of the United States Patent and Trademark Office:

1. Direct the CIO and Commissioner for Patents to work with examiners to ensure that increased examiner involvement continues throughout the search system life-cycle.
2. Direct the CIO, the Commissioner for Patents, Commissioner for Trademarks, Chief Financial Officer, and Chief Administrative Officer to work with end users to formally define and document end users' increased responsibilities in the life-cycle for major information systems.

B. USPTO Response and OIG Comments

USPTO concurs with our recommendations and has started implementing them. It stated that management has offered examiners an expanded role in life-cycle activities in a formal agreement with POPA. Also, USPTO is considering how to define and formally document an expanded role for end users from other USPTO units.

**VI. Users' Proficiency Needs to Be Ensured
Before Systems Become Operational**

Although schedule delays prevented training of the examiners on the new search system from being completed, USPTO believed that they were proficient enough to use it. However, training proved to be insufficient, and examiners had difficulty using the system. USPTO should evaluate the proficiency of examiners before new systems are placed into operations and adjust training accordingly.

Although BRS was selected, in part, because it was the most similar to Messenger of the search systems evaluated, examiners still needed training because the two systems had substantial differences, especially in user interfaces and processing of search queries. Messenger had a simple user interface consisting of a single window and a single command entry mode.

Examiners used the keyboard to enter commands and results appeared in the same window right after the command. However, EAST has a more powerful and more complicated interface based on Microsoft Windows, which has multiple windows and command entry modes. Commands are either keyed in or selected with a pointing device (e.g., a mouse) from menus, toolbars, tabs, and other areas of the desktop computer monitor screen. Results appear in one of three windows that can be re-sized and moved around the screen.

Examiners also had to learn new search strategies because BRS processes some search queries differently from Messenger. In some cases, the results returned by BRS and Messenger differed for identical queries. In other cases, BRS would respond very slowly to search queries examiners typically used with Messenger. To overcome slow responses, examiners have to narrow the scope of the query or break long search queries into several smaller queries.

USPTO developed a series of courses for training examiners on EAST and WEST. WEST training was primarily for learning BRS search strategies, since WEST's web browser-like user interface was easy to understand. Because EAST had a more complicated user interface, EAST training was divided into two components, user interface training (including patent image retrieval) and search strategy training.

EAST and WEST training was supposed to be completed before Messenger was shut off, at the end of September 1999. However, because of delays in getting WEST and EAST ready and system problems during training, training for both systems started late and was not completed on time. WEST training started two months late at the end of June 1999 and was not completed until November. Also initially, participation in WEST training was low because examiners were not required to take the course. EAST was also delivered late, delaying the start of training until August. This delay left little time to fully train the entire examining corps before Messenger was shut off. Therefore, examiners who relied heavily on patent image retrievals were the first to receive EAST user interface training. EAST search strategy training did not start until three months after EAST went into stand-alone operations, and was not completed for another three months.

Although program managers realized that EAST training could not be completed in time, they believed that WEST search strategy training might have prepared examiners for using EAST, since both systems are served by BRS. However, USPTO did not have data to make a more certain determination of examiners' preparedness for using EAST. After EAST went into operations, many problems were attributed to users' lack of familiarity with the system. In response to this issue, USPTO revamped the training program for EAST and WEST. New training courses were developed, and examiner training time for both EAST and WEST was increased from 8 to 20 hours.

As a result of their experience with the new search system, USPTO managers have stated that they have an increased appreciation for the role of training in making their work force efficient users of technology and that they plan to allocate more training time in the future.

A. Recommendations

We recommend that the Under Secretary for Intellectual Property and Director of the United States Patent and Trademark Office direct the Commissioner for Patents to take the following actions before a major information system goes into operations:

1. Ensure that end users have been completely trained.
2. Ensure that the proficiency of end users has been evaluated.

B. USPTO Response and OIG Comments

USPTO concurs with our recommendations and has started implementing them. It has expanded the automation training program and will allow examiners to retake courses without time penalties. Although the labor unions have expressed concern about assessing the proficiency of employees, USPTO will explore mechanisms for assessing skill level on new systems before old systems are retired.



UNITED STATES
PATENT AND
TRADEMARK OFFICE

Appendix

Under Secretary of Commerce For Intellectual Property and
Director of the United States Patent and Trademark Office
Washington, DC 2023
www.uspto.gov

FEB 21 2001

MEMORANDUM FOR Judith J. Gordon
Assistant Inspector General for Systems Evaluation

FROM: *Nicholas P. Godici*
Nicholas P. Godici
Acting Under Secretary of Commerce for Intellectual Property and
Acting Director of the United States Patent and Trademark Office

SUBJECT: Inspector General Draft Inspection Report "Search System Problems
Being Addressed, but Improvements Needed for Future Systems"
OSE-12679

Thank you for the opportunity to review and comment on the draft inspection report "Search System Problems Being Addressed, but Improvements Needed for Future Systems". I appreciate the thoroughness of the review conducted by your Office, and the many constructive suggestions offered in the report. We concur with the major findings of the report and have begun implementation of many of the recommendations. Our formal response to the report is attached.

Attachment

RESPONSE TO IG DRAFT INSPECTION REPORT ON SEARCH SYSTEMS OSE-12679/DECEMBER 2000

OVERVIEW

The U.S. Patent and Trademark Office (USPTO) agrees with the overall findings of the Inspector General (IG) Draft Inspection Report No. OSE-12679 that the newly deployed search systems are adequately supporting patent application processing. In addition, the USPTO agrees with the substance of the recommendations from the IG Report that can be applied to future system programs. The USPTO concurs with the IG Report that there were initial transitional issues with the new search systems and that the USPTO acted quickly to address those issues.

The USPTO has made enhancements to its Examiner Automated Search Tool (EAST) and Web-based Examiner Search Tool (WEST) search systems in addition to the improvements noted in the Draft Report. Further, the USPTO has already started to implement many of the recommendations made in the report.

It is important to note that the transition to the new search systems did not negatively impact the performance of USPTO employees. No examiners lost promotions or missed award opportunities as a result of this transition. The USPTO met its production goals for FY 2000, while making the upgrade to the new search systems. Use of automated search systems by patent examiners at the time of this transition was voluntary, and in fact still is voluntary. The paper search files were always available for examiner use throughout the deployment of the new systems. With the deployment of the new search systems, plans for paper search file removal, a long-standing USPTO business objective, can move ahead.

A key finding of the IG Report is that the USPTO's "new search system's performance has improved, and it has largely fulfilled its primary goal of overcoming Messenger's limitations." Evidence of the improvement that has been made can be found in the new *Agreement on Initiatives for a New Millennium* reached with the Patent Office Professional Association (POPA) to eliminate paper search files and rely entirely upon the new automated search tools. The *Agreement on Initiatives for a New Millennium*, signed January 4, 2001, calls for the elimination of the U.S. patent paper search files in yearly 25% increments, starting this year. This of course means that examiners must rely entirely upon the new automated search tools, primarily EAST and WEST. This agreement was ratified by an overwhelming 93% vote of the POPA membership.

This perspective is also evident in the recently concluded Automation Census, conducted among patent examiners. According to the Automation Census, fully two-thirds of the examiners responding state that they could give up their paper search files now and rely entirely upon the new automated search tools. These are strong testaments to the acceptance the patent examiners have for the new search tools, little more than a year after replacing the old Messenger-based automated search tools and deploying the BRS-based EAST and WEST systems.

The discussion of the issues below is organized by the same sections as used in the Draft Report, concluding each section with the recommendations made in the Report and the specific actions we have taken or intend to take to further address those recommendations.

BACKGROUND

Although briefly mentioned in the Report, it deserves to be restated that a key contributor to the transition issues experienced was the delay caused by the General Services Administration's (GSA) temporary suspension of procurement of system development and maintenance services. Budget cuts before and after the suspension compounded the delays in development.

The Report states in several places, most notably on page 5, that "EAST and BRS...were the primary replacement for Messenger." To clarify, BRS is the primary replacement for Messenger. EAST is the primary replacement for the Image Search and Retrieval (IS&R) client that examiners had used for retrieving patent images. Both EAST and WEST, independently, were intended to replace the STN Express (a commercial product of STN International) client that had previously been used to access the Messenger search system. Notably, either EAST or WEST can be used to provide both text and images, something that could not be done with the systems they replaced.

The Report states, in the second paragraph on page 4, that WEST was deployed in June 1999. It is important to note that while this was the first version of WEST that employed the new BRS text search engine for U.S. patent text, it was not the first version of WEST, nor the first version to use BRS. WEST 1.0, which used BRS for the Derwent World Patents Index, was actually deployed in August of 1998.

The Report notes on page 3 that WEST "is less capable than EAST" and states that "WEST was developed as a prototype". These statements are not correct. The predecessor to WEST, Global Patents Index (GPI) Web, was originally developed as a prototype, and eventually became a production system. But WEST was intended from the beginning to be a production system, and has been a production system since August of 1998.

As for capabilities, WEST's focus is different than that of EAST, and it consequently has different features. Both EAST and WEST have the same overall capabilities. WEST was designed to provide state of the art text search capability in an easy to use web browser interface while EAST was designed to be more configurable to meet individual user preferences and provide faster image retrieval performance. But both provide access to all patent text and image data and do so in roughly equivalent ways.

These are important distinctions because they were at the heart of the USPTO's risk mitigation strategy for dealing with the time pressure brought about by the various schedule delays and the impending Year 2000 cutoff of Messenger. We intended to have a year of parallel operation of the new BRS search system with the legacy Messenger system. By bringing up WEST 1.0, using BRS for the Derwent database, in August of 1998 we at least partially achieved that goal.

FINDINGS AND RECOMMENDATIONS

I. Management Has Addressed Many Problems Effectively

As noted earlier in this Response, we agree with this finding. We took early and aggressive steps, from deploying a more powerful server in November 1999, to providing more flexible work schedules, to alleviate the transitional impacts of the new search systems.

The Report notes, for example, that "text search response time has been reduced from approximately 50 seconds in November 1999 to less than 20 seconds in December 1999." Although the response time in December 1999 met the service commitment, we have continued to make steady improvements and the average text search response time for EAST is now less than 15 seconds while BRS is now supporting up to 600 simultaneous users.

One minor point of clarification—The Report notes that "EAST and BRS response time still has not met the service commitment for some of the new search query benchmarks specified by examiners." In point of fact, we do not have a service commitment for individual search queries—only for overall, average response time. The benchmark queries were created so that we would have sample, representative queries of varying complexity for each of the Technology Centers so that we could judge improvements over time. Some of those queries would have taken extended periods of time to run under the previous Messenger system and would not have fallen within the "80% in 30 seconds" service commitment under that system either.

II. Decision Authorities Need to Be More Involved and Have Better Progress Information

The USPTO agrees that involvement and communication with Decision Authorities are essential to successful automated system development. In the report, the statement "neither the CIO [Chief Information Officer] nor the Patent Commissioner was aware of the severity of the system's stability problems until it went into operations" implies that the new search systems were deployed with known stability problems. At the IG exit interview, the CIO took exception to this statement, stating that he had been kept informed throughout all phases of the project. The development team believed the system had been stabilized prior to production operation. As more and more examiners used the system, once Messenger was turned off, additional stability issues became apparent that had not been previously uncovered or that the development team thought had been solved.

Currently, technical reviews are performed to provide high-level visibility into an Automated Information System's (AIS) functional and technical characteristics, as well as establish management control points for assessing project cost, schedule, and quality. At least one review occurs in each of the Concept, Detailed Analysis and Design, Development, and Deployment phases. The Deputy CIO for Information Technology Services chairs the Technical Review Board (TRB) and its members consist of the senior managers from the major CIO organizations. At the conclusion of each TRB meeting, the Chair, TRB members, the System Development Manager, and the Project Manager sign the approval/disapproval for the project to move forward. The Project Manager, who reports to the business Program Sponsor, is the business manager representing the business needs and users. TRB meetings are open meetings and may be attended by any interested party.

We feel that the TRB process provides appropriate visibility to senior management and our business partners regarding the activities in each phase of the life cycle for most projects. In addition, on a quarterly basis, the Patent Commissioner and the senior executives are briefed by each of the business areas, the support organizations, and the CIO using a Balanced Scorecard format. This quarterly briefing provides another opportunity for the exchange of information regarding key issues in AIS development.

Recommendation 1: [Revise the Life-Cycle Management (LCM) for major information system programs to] extend the decision authorities' responsibilities to reviewing and approving the completion of the detailed analysis and development phases.

USPTO feels that both the TRB process and the quarterly briefings provide adequate visibility to senior management and our business partners regarding the activities in each phase of the life cycle for most projects.

Recommendation 2: [Revise the LCM for major information system programs to] require that quantitative measure be prepared and that the decision authorities review them at the end of each life-cycle phase to help evaluate the progress made in achieving program commitments, such as cost, schedule, and high-level requirements.

USPTO agrees with the recommendation. In 2001 the Software Engineering Process Group (SEPG) will undertake an effort to identify life cycle metrics that should be collected, tracked, reported, analyzed, and acted upon. The SEPG will investigate industry best practices and identify appropriate life cycle metrics, processes, and procedures in a Technical Standard and Guideline (TSG). Once the TSG is approved, the appropriate metrics will be collected, presented at the TRB reviews, and used to evaluate the progress and quality of the AIS.

Recommendation 3: [Revise the LCM for major information system programs to] require the decision authorities to sign documentation attesting to the successful completion of each life-cycle phase.

At least one review occurs in each of the Concept, Detailed Analysis and Design, Development, and Deployment phases. The Deputy CIO for Information Technology Services chairs the Technical Review Board (TRB) and its members consist of the senior managers from the major CIO organizations. At the conclusion of each TRB meeting, the Chair, TRB members, the System Development Manager, and the Project Manager sign the approval/disapproval for the project to move forward. The Project Manager, who reports to the business Program Sponsor, is the business manager representing the business needs and users. TRB meetings are open meetings and may be attended by any interested party.

III. System Requirements Need to Be Fully Specified

Recommendation 1: Revise the LCM procedures for specifying requirements to ensure that all requirements are identified and fully specified according to the categories and level of detail stipulated in the IEEE [Institute of Electrical and Electronic Engineers] standard.

The OCIO has recently completed a draft revision of the LCM that has been forwarded to USPTO business units for review and comment. The revised LCM draft adds an additional requirements review (Detailed Level Requirements Review) to the life cycle. The intent of the additional review is to provide greater visibility into the requirements definition process, resulting in higher quality requirements specifications. As a result of the LCM changes, several of the TSGs will be revised, including the existing Requirements Management Technical Standard and Guideline, IT-212.3-11. While the existing TSG is based on the

IEEE Std-830, we will use the IEEE Std-830, 1998 in the revision of our TSG and more fully address the categories identified in that standard.

Recommendation 2: Update the new search system requirements specification to include fully specified text search response time (including workloads) and system availability.

This recommendation has already been adopted. New search system performance and availability requirements or service level standards are being drafted to adequately quantify requirements at both a system level and a component level.

IV. Acceptance Testing Needs to Be Improved

The USPTO agrees with the recommendation that acceptance testing procedures should be improved to ensure that systems are ready for operations.

Some statements in the IG Draft Report require elaboration. The Report states that "significant stability and response time problems...were overlooked." Stability and response time issues were corrected as identified and additional ones only came to light after production deployment. The releases of WEST 1.1a and of EAST were repeatedly delayed, and the systems changed, as problems were identified. The Report notes, for example, that there were "four releases of EAST before Messenger was shut off on October 9 to fix problems found during beta testing."

AIS stability and performance are extremely important to the USPTO. Search system development teams worked hard to identify problems and fix them before putting the systems into production. It is true that more problems were uncovered after the systems came under full load in October 1999. As those problems were identified, the team worked quickly to resolve those as well. As the Report states on page 6, by "May 2000, USPTO released four software enhancements to EAST and doubled the memory size of the client desktop computer to reduce the number of system crashes." At the same time, there were also BRS system enhancements made to improve stability and performance.

The Report states that "system response times should be tested under workloads expected during operations" and notes that FQT was tested, "with a workload of 3 simultaneous users, when the system was expected to handle 600." The implication is that no stress analysis was performed and therefore USPTO had no idea whether the system would perform adequately under a full load. In fact, during development a stress analysis was performed by an independent contractor, by taking representative search queries and simulating a load of 600 simultaneous users.

The WEST 1.0 deployment of Derwent in August 1998 and the WEST 1.1/BRS pilot between November 1998 and May 1999 gave EAST and WEST developers hard data that could be extrapolated to a "full-load" scenario. That experience was used to tune the system for full U.S. patent production in May 1999. Indeed, many changes were made to the WEST 1.1 pilot software and the underlying BRS system during the course of that pilot. The system continued to be tuned as necessary, right up until Messenger was retired in October 1999.

Recommendation 1: Revise the LCM procedures for Formal Qualification Testing to ensure that
a. End users participate in developing realistic test cases.

b. Systems are tested at and beyond system boundaries (i.e., are stress tested), in addition to being tested in average situations.

c. System requirements are tested under realistic conditions.

Currently the Project Manager, with assistance from the System Development Manager, prepares the Requirements Specification. Using the specification, Test Specifications and Procedures are developed. To strengthen the test cases, the Office of the Chief Information Officer (OCIO) will work more closely with the Search and Information Resources Administration (SIRA) to more frequently include real scenarios used by examiners in the test cases. Currently, the Test Specifications and Procedures are reviewed by the System Development Manager. We will recommend to the SEPG that they consider modifying the Testing TSG to ensure that the Project Manager also reviews the document.

To the extent possible, USPTO automated systems are tested under realistic conditions; however, it is not always possible to simulate production conditions in a test environment. Strengthening our test environment and obtaining additional tools for testing beyond system boundaries will require additional resources. Budget requests will be made for funding to specifically address improving our testing capabilities, i.e., testing environment and stress testing resources.

Recommendation 2: Revise the LCM procedures for beta testing to ensure that

a. Beta test plans are prepared that include plans for testing important requirements in addition to ad hoc testing.

b. A written end user evaluation of the test is required as one of the determinants of the deployment decision.

Currently, requirements are specifically tested during Functional Qualification Testing (FQT). Beta testing provides an opportunity to retest those same requirements by end users in the course of doing production work. USPTO agrees that beta testers need more guidance and SIRA is in the process of drafting beta testing guidelines, including the direction that important requirements be emphasized and specifically tested and that written end user evaluations be submitted as part of the business case that a system is ready for production.

USPTO also intends to increase the visibility that beta testing has in the formal system life-cycle. Beta test results are reported at the Production Readiness Review. The Office of System Product Assurance (OSPA) has undertaken an effort to review and standardize the briefing templates used to present information and results at the TRB meetings. Both the Beta Readiness Review and the Production Readiness Review are key reviews that will be included in the process of standardizing the templates.

Recommendation 3: Revise the LCM testing procedures to ensure that the adequacy of the testing performed by the developer is reviewed before acceptance testing begins.

The USPTO agrees that products must be adequately tested by developers prior to USPTO acceptance testing. Unit, integration, and independent acceptance testing activities are

performed during the Development Phase. Unit and integration testing are performed under the direction of the Project Manager and System Development Manager. The results of the unit and integration testing, in the form of discrepancy reports, are presented at the Test Readiness Review. As stated above, the SEPG will identify appropriate life cycle metrics, to include testing metrics. The testing metrics will serve as an indicator of the quality of the system at the Test Readiness Review.

V. Communication with End Users Needs to Be Improved

The USPTO agrees, and has taken appropriate measures to improve end user communication.

The title of this section refers to communication, but the discussion in the Report largely focuses on end user involvement in life-cycle activities. The Report recommendations in this area are directed to increased examiner involvement. We agree with the Report's observation that increased communication can play a key role in enhancing examiner satisfaction with new system deployments. In order to enhance our communication effort we have established the Director's on-line chats, the Automation Task Force, the Automation Partnership, and created public e-mail folders and system web sites. This is an important area we are constantly working to improve.

The USPTO agrees that further involvement of AIS end user populations will improve customer satisfaction and help smooth the transition to new automated tools. Accordingly, under the *Agreement on Initiatives for a New Millennium* the examiners, both directly and through their union representatives, will be offered a greatly expanded role in life-cycle activities. The USPTO welcomes this and is taking steps to accommodate this expanded union role. Even prior to the agreement, POPA was invited to have an observer at Technical Review Board meetings.

Recommendation 1: Direct the CIO and Commissioner for Patents to work with examiners to ensure that increased examiner involvement continues throughout the search system life-cycle.

The USPTO agrees with the principle that increased examiner involvement enhances acceptance of new automated tools and will work to expand examiner involvement. In addition, the new *Agreement on Initiatives for a New Millennium* with POPA involves examiners in all phases of the system life-cycle.

Recommendation 2: Direct the CIO, the Commissioner for Patents, Commissioner for Trademarks, Chief Financial Officer and Chief Administrative Officer to work with end users to formally define and document end users' increased responsibilities in the life-cycle for major information systems.

Each USPTO business unit involves their respective end user communities in system life-cycle activities in ways that contribute to the overall objectives of those areas. For the Patent Business, SIRA has the primary role in involving end users in life-cycle activities. This involvement of end users will continue to expand. Moreover, the *Agreement on Initiatives for a New Millennium* further strengthens the role of end users in system development activities. The OCIO, including the SEPG, is reviewing the POPA agreement and considering how to formally document increased end user responsibilities, while maintaining flexibility for each business unit to involve end users in appropriate, constructive ways.

VI. Users' Proficiency Needs to Be Ensured Before Systems Become Operational

The Report suggests, on page 15, that "USPTO should evaluate the proficiency of examiners before new systems are placed into operations and adjust training accordingly." As an expression of a goal, the USPTO has had long-standing agreement with this statement. In practice, it is sometimes difficult to do. USPTO labor unions have expressed great concern about proficiency assessment of employees, before, during or after AIS deployments. Nonetheless, the USPTO will pursue mechanisms to assess skill levels of employees to assist in the transition to automated work environments. An approach that will be examined is to "evaluate the proficiency of examiners on new systems before the legacy systems are retired." Even that is not always possible, but it is more attainable.

The issue of employee proficiency is tied closely to that of training. The Patent Business has placed great emphasis on automation training, and has created a formal Automation Training program for all patent examiners that includes mandatory and elective classes. This program will permit examiners to register for courses they deem as appropriate for their skill level, and to take courses of particular interest to their business needs.

Recommendation 1: [Direct the Commissioner for Patents] to ensure that end users have been completely trained [before a major information system goes into operations].

The Patent Business has revamped and expanded its automation training program to allow for both mandatory and elective training. In addition, the Patent Business has committed a block of twenty hours of automation training time and fifteen hours of practice time, allotted to each examiner each year for automation training. We are also continuing our practice, initiated in the migration to EAST and WEST, of offering overview training courses on selected topics. To further ensure that examiners are given ample opportunity to be adequately trained the *Agreement on Initiatives for a New Millennium* documents that we will be allowing examiners to retake courses without that time counting against the examiner's discretionary training account.

Recommendation 2: [Direct the Commissioner for Patents] to ensure that the proficiency of end users has been evaluated [before a major information system goes into operations].

Although USPTO labor unions have expressed great concern about proficiency assessment of employees, establishing metrics on examiner proficiency is an area the Patent Business continues to pursue as a matter of good business practice. Currently, through automation training course evaluations after each class, examiners are able to make some assessment of their learning experience and proficiency. The Patent Business will continue to explore other ways of actually measuring and certifying end user proficiency.